Crop Protocol
Legume Crops

French beans, sugar snap peas, cowpeas, pigeon peas and lablab

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Why eat Legumes?

Legumes are important in the diet because they contain about 20% protein. They are also a rich source of iron and the B vitamins. Ideally a legume which both the seed and the pod can be eaten is the best choice for a Nutrition Garden, to avoid wasting nutrients by discarding the pod.

Why grow Legumes?

Peas and beans are in the Legume family. Legumes are an essential part of any crop rotation for soil fertility because they efficiently contribute nitrogen to the soil after they decompose – making it available to other plants.

During the life of a legume plant, a soil bacterium associated with their roots *(Rhizobium*) is able to fix nitrogen gas from the air spaces in the soil and turn it into a form that can be used and assimilated in the plant. Legumes are the only plants that can do this.

It is a common misconception that plants growing near to a legume plant will benefit from availability of nitrogen.

This does not happen straight away and only happens if the dead legume is later incorporated into the soil when it decomposes – that's when the nitrogen is released and made available to other animals or plants. This is part of the 'Nitrogen Cycle'.

Rhizobium is a free living soil bacterium which is attracted to the roots of legumes. When *Rhizobium* infects the legume roots, the plant reacts to this infection by creating a tumour around the site. This is the 'nodule' on the roots.

Fig 1: *Rhizobium* nodules on the outside of legume roots

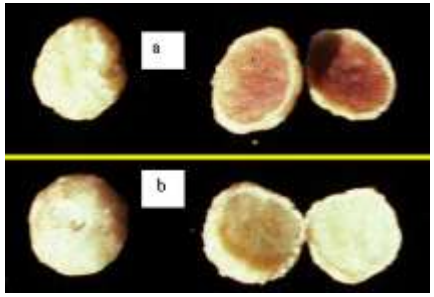

Fig 2: Effective *Rhizobium* nodules (a) on the outside of legume roots are pink inside and non-effective nodules (b) are cream coloured.

The Rhizobium 'nodules' (Fig 1) are on the outside of the root and can be rubbed off by hand. This makes them easy to distinguish from infection by root knot nematode, which is not on the outside of the root. Root knot nematode 'galls' are swellings within the plant root and cannot be rubbed off.

Choice of Legume

Nutrition Gardens need to protect and develop soil fertility in order to ensure sustainability. The Rotation Plan alternates three types of plants in the following order: Legumes ➔ Leafy ➔ Root

Rotation is explained in the Planting Programme section of this leaflet.

Not all legumes grow equally well in different climates. Therefore the choice of Legume will depend on the region.

French beans (*Phaseolus vulgaris* var nanus)

French beans are not drought tolerant and need adequate irrigation and good soil fertility. They are more tolerant of a range of temperatures than sugar snap peas and do not need plant supports to grow, since they are compact plants.

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Fig 3: French beans

French beans are also known as fine beans, snap beans and string beans. However, it is important to recognise that the specifications for French Beans grown in a Nutrition Garden are different to a French bean grown as an export crop.

French beans are exported as a 'fine bean' (thin and short). For a Nutrition Garden, the beans would be a heavier bean, longer and fatter, to optimise the nutrition / food value of the product. These would be considered as 'over specs' and rejects for exports.

Fig 4: French beans

French beans are eaten without removing the pod – unlike common beans and many other legumes grown in East Africa. Because the pods are also eaten, the nutritional value and the total yield per meter square is higher than for other legumes This would be the same with sugar snap peas – since the pod is also harvested and eaten.

Both French beans and sugar snap are export crops, so there is an added market potential for any excess production.

Sugar snap peas (*Pisim sativum* var macrocarpon)

Sugar snap peas are eaten with the pods intact when the peas inside have swollen but whilst the pod is still tender. The pea pod is cooked entire, like French beans.

Fig 5: sugarsnap peas

Sugar snap peas do not grow as well in areas where it is very hot. Heat stress will cause flower abortion. They prefer cooler climates found in higher altitudes and a minimum altitude of 1500 meters is advisable.

Sugar snap peas are an important export crop and an understanding of how to grow sugar snap peas as a livelihoods activity is an extra dimension to a Nutrition Garden. This should not however compromise the human nutrition component and the Nutrition Cook Book will guide communities and families to ensure that the excess is sold only after sufficient is consumed to provide for a balanced healthy diet.

Fig 6: sugarsnap peas

Plant supports made of simple short posts (1 meter high and 5 meters apart) with strings are needed to stop the peas from collapsing on the ground. The peas are simply tucked into the strings as they grow.

Cowpeas (Vinga unguiculata)

Cowpeas are also known as black eyed peas and are adapted to dry land cultivation, requiring warm soil temperatures to germinate. Cowpeas have a deep tap root and need good seed bed preparation to achieve optimum yields.

Fig 7: cowpeas / black eyed pea

Although cowpeas are usually grown for the mature dried seed, the leaves can also be eaten as well as the young green pods and fresh shelled green peas. They take about 16 weeks to mature.

Fig 8: mature cowpea pods

The spacing of the plants will depend on the type of crop to be harvested (leaf, fresh bean, or dry bean etc.).

There are large seeded cowpeas with determinant growth which can be planted at high density (2 – 3 inches apart with rows 20 inches apart) and indeterminate vine types (8 – 9 inches apart with rows 30 inches apart). Plant seeds 1.5 inches deep, with good soil contact.

Fig 9: Cowpeas are a compact, bushy plant which does not require plant supports.

Pigeon peas (*Cajanus cajan*)

Production of pigeon pea is most valuable in semi-arid areas, since it can grow in areas where rainfall is less than 650 mm of rain annually.

Pigeon pea varieties can be either the indeterminate type, which is a perennial crop of 3 – 5 years duration or the determinate types of medium to short duration which mature in either 8-10 months or 2 to 5 months respectively.

The new short duration pigeon peas are of most value in a Nutrition Garden because they only occupy the ground for similar lengths of time as the root and leafy crops with which they are rotated (carrots, sweet potato, cabbage, shorter duration spinach).

Fig 10: Pigeon pea plant form

Long maturing, perennial pigeon pea would have to rotate with a root and leafy crop which had a similar, long maturity period (cassava or a long term spinach crop).

Pigeon peas from a Nutrition Garden may be used as a green pea or dried for later use.

Fig 10: Pigeon pea (fresh)

Dried peas can be ground into flour or sprouted and then cooked to make it more digestible and nutritious. The pigeon pea foliage can be used as forage or as a green manure crop, providing more than 40 kg of nitrogen per hectare.

Additional uses of pigeon peas include the use of woody stems as plant supports, firewood, fencing and thatch.

Common beans (Phaseolus vulgaris)

Common bean is grown throughout East Africa. Although there are both determinant and indeterminate types, the most usual crop grown is a compact determinant type.

The leaves and young pods can also be cooked and eaten like spinach or sugarsnap peas.

Fig 11: Common beans

Lablab (*Lablab purpureus*)

Lablab is a drought tolerant legume capable of growing in areas with 650 mm of rain and up to 3,000 mmm of rain. It is known in Kenya as njahi bean and elsewhere as hyacinth bean.

Both young pods and flowers can be eaten as a vegetable; whilst the mature beans are removed and dried to produce familiar njahi bean.

Fig 12: dried njahi beans

Lablab is also used as a fodder crop when grown more extensively. The most appropriate way to grow lablab in a Nutrition Garden is as an immature bean, cooking it whole with the pod. Lablab is tolerant of a range of temperature (down to 3°C) although daily temperatures of 18-30°C are optimal

Fig 13: Lablab pods

Lablab seed should be planted to a depth of 3 – 10 cm, dependng on soil type (deeper in sandy soils, shallower in loamy soils) Lablab is not normally grown in a bed, but instead as an extensive mono-culture.

If adapating this legume to a drip irrigation system on beds, a spacing of 50 cm between plants in a row is suggested; with two rows per bed next to drips lines spaced 60 cm apart. Use a zig zag pattern in the planting to optimise the space available to each plant.

Nutrient content of legumes

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	Protein	Vit A	Vit C	Vit B6	Vit E	Iron	Calcium	Folate
French beans (fresh)	4	14	16	3	2	4	4	8
sugar snap (fresh)	7	21	80	7	2	11	4	7
cowpea (fresh)	15	0	1	5	1	14	2	52
pigeon pea (fresh)	14	0	0	3	0	6	4	28

Table 1: % RDI from 100 grams of cooked legumes

AGRONOMY for LEGUMES

The Nutrition Garden is designed on a bed system to facilitate rotation and improve soil management (drainage and fine tilth for small seeds etc.). Legumes will therefore be planted on a bed system using two or three lines of drip irrigation depending on the planting density.

Nutrition Gardeners should aim to grow a legume which gives the highest yield per meter square in their agro-climatic zone. If irrigation is available all year round, the legumes of choice will be fine beans and sugarsnap peas. If there is less rainfall and an unreliable water source for the drip irrigation then one of the other types of legume crops described above should be used.
Since the legumes have different growth habits, the planting density per meter square will differ. The Nutrition Gardener will have to experiment to decide on the best plant spacings within the row and between the rows to get the highest overall yield.

The important difference in a Nutrition Garden is that the Gardener and Cook will collaborate to utilise fresh young, green pods and leaves rather than allow the pods to grow to maturity and harvest only the seeds for drying and cooking. However, the ability to grow legumes such as cowpea and pigeon pea to maturity is very important in semi-arid areas so that the community can have dried seeds to eat between the rains. Additional legumes need to be grown for this special purpose – as a 'food bridge'. This does not prevent Nutrition Gardens, even in semi-arid areas, from growing and eating young pods and leaves of cowpea and pigeon pea in the periods when water is available for irrigation.

Legume	Lines of plants per bed	Spacing between plants within a row	Spacing between rows	Total plants per m.sq.
French bean	3	15	30	21
common bean	3	30	35	9
sugar snap	2	15	35	14
cowpea leaf (Kunde)	6	10	20	60
cow pea (young pea pods)	3	30	35	9
pigeon pea	2	15	35	14
Lablab	3	30	35	9

Table 2: Planting Density

General Fertiliser Recommendations

Nitrogen and Phosphate

Excessive amounts of nitrogen will restrict nodulation by Rhizobium bacteria in the soil and reduce nitrogen fixation. Nitrogen fertilizers in small amounts (5 to 15kg N/ha – or 2 grams of Nitrogen per meter square) are not harmful to nodulation and can be beneficial by pushing out the early root growth to establish a stronger plant.

This amount of nitrogen would be available from a DAP base dressing of about 20 grams per meter square.

Phosphate will also be applied in the DAP base dressing. Since phosphate is not very mobile in the soil, it is best to apply this as a band fertiliser 3 – 4 inches deep and 3 inches away from the seed.

Seeds can be treated with commercially available Rhizobium bacteria.

If the grower is an organic grower and does not wish to use DAP - add vermi-compost at 1 kg/m^2.

Foliar sprays-

- Vermi-liquid at 1:10 dilution – one 15 Litre knapsack per 100 meter square – every week.

Topdressing-

- Apply 80 g/m^2 of CAN at the start of flowering (25-30 days after sowing).

Seed planting method

Seeds should be planted one to one-and-a-half inches (2.5 - 4cm) deep

The planting distance between seeds within a row and between rows is detailed in Table 2.

Stringing Up

Peas may need to be given some support, even if they are the determinant type. Plant supports can be as simple as some string tied between two posts, but they must be in place as soon as the crop is 20 cm high. Delays in providing plant supports will result in loss of yield and quality due to disease.

Planting Programme

Crop Rotation

Legumes should not be either continuously planted in the same place.

Other crops not in the Leguminosae family, and that are considered bad 'previous crops' because they share similar pests and diseases, include:

- potato
- eggplant
- melon
- cucumber
- zucchini
- watermelon
- lettuce
- okra

Legumes should be planted after a Root Crop which will have removed a lot of nitrogen from the soil. For, it will fix nitrogen in the soil for use by leafy crops in the next season. Examples of suitable crops which could have been planted earlier in the same piece of land include:

- cereals (maize, sorghum, millet, fodder grass)
- turnip
- beetroot
- cassava
- sweet potato

French beans and sugarsnap peas are considered part of the Legume Crops in the rotation plan and are grown after the Root crops in the rotation (carrots, onions or leeks and sweet potato) and before the Leafy crops (cabbage and spinach)

French beans are in the ground for about 10 – 12 weeks. There are no suitable legume crops that are in the ground for 20 weeks. Therefore the French beans are planted TWICE (in 20 weeks) the same ground, in the longer rotation group described below – but only ONCE in the shorter rotation group.

There are two Rotation Groups – one for crops that are only in the ground for about 12 weeks (fine beans, cabbage and carrots) and one for crops that are in the ground for about 20 weeks (2 crops of French beans, continuous cropping spinach and sweet potato).

Rotation Group	weeks in ground	LEGUME Crop	LEGUME crop planting interval	LEGUME crop area planted	ROOT crop	LEAFY crop
1	12	1 crop of French Beans	4 weeks	2.5 m.sq	50% (leeks) 50%. (carrots)	cabbage
2	20	2 consecutive crops of French beans	2 weeks	5 m.sq	sweet potato	continuous harvest of spinach

Seek advice from your Real Impact Agronomist on the planting interval and the meter square to be planted each time.

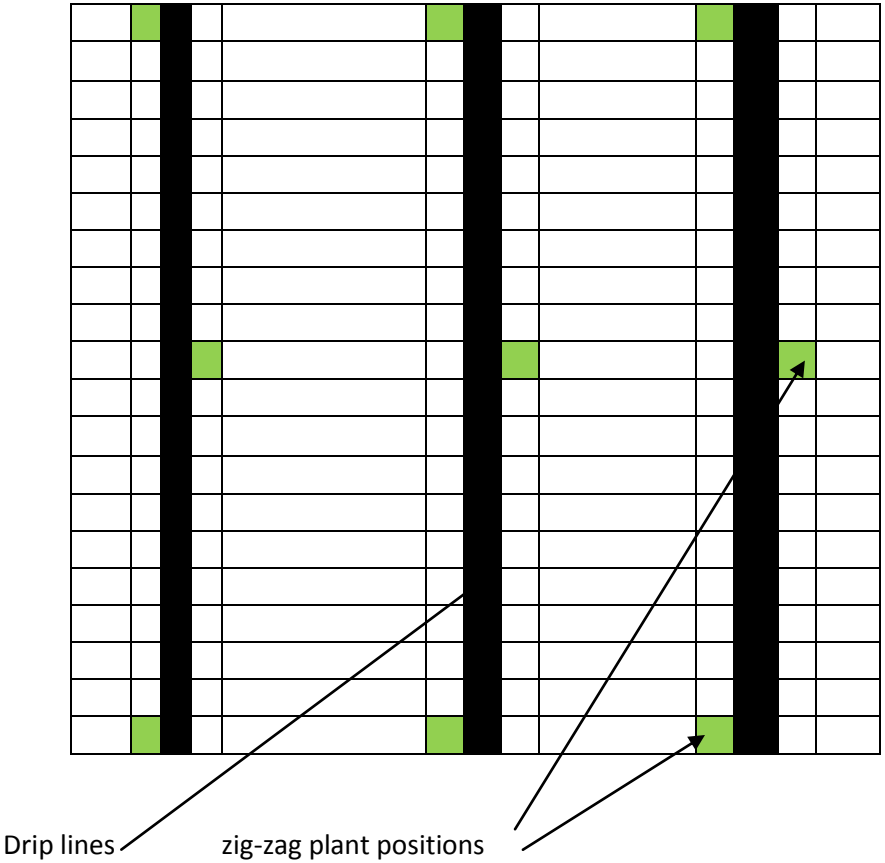
A general guide for a small Nutrition Garden with 20 beds, each only 10 meters long, is to plant the areas in the table above, at the weekly intervals stated.

Bed preparation

There is some variation in the planting pattern depending on the type of legume grown (See Table 2). The guidelines below for French beans can be adapted to suit the other legumes.

- 3 rows will be planted per bed, so place 3 drip lines equally spaced on the raised bed.

- Plant seeds in a zig-zag pattern on either side of the drip line to reduce the competition between plants.



Harvesting

Take care when harvesting not to damage the leaves and stems, so that the plants can continue cropping for as long as possible and increase the overall yield.

MAIN FRENCH BEAN PESTS

Spider mites

These are very small 'spiders' which live mostly on the underside of the leaf and suck the sap from the plant, casing stunting and possibly leaf drop.

Figure 14: Spider mite

If the grower does not use pyrethroid or organo-phosphate sprays to kill pests, it is common to observe predatory mites and other arthropods in the crop, eating the spider mite.

Fig 15: predatory mite eating spider mite

When pest population is very high the webbing made by the mites can be seen on the top of the plant and on posts.

Fig 16: spider mite webbing on a post

Spider mite can be 'washed' off the plant with water, if there is a plentiful supply. Otherwise the diluted detergent spray recommended in the Leafy Crops protocol for aphid control can also suppress mites. Take care not to spray detergents in hot weather or bright sunlight as leaf scorch may occur.

Thrips

Legumes can suffer from thrips damage, which appears as silvery flecks on leaves where the thrips have been scraping away the green flesh of the leaf. Thrips damage usually also has small black specks with it – this is the faeces of the thrips.

Fig 17: thrips life stages from egg (left) to adult (right)

Detergent sprays will help suppress thrips and the same predator that feeds on spider mite will also eat young thrips.

Thrips pupate in the soil. High organic matter content of soils will encourage the beneficial fungi which kill the pupae and pre-pupae of thrips which are in the soil.

Root Knot Nematode

Legumes often suffer from attack by root knot nematode. The nematodes live in the soil and can also be present in irrigation water from rivers. They attack the roots causing 'galls' which spa the plant of energy and can cause severe stunting.

Fig 18: root knot nematode

Root knot nematode can be distinguished from beneficial Rhizobium bacteria because the root 'knot' is not superficial (like the Rhizobium 'nodule') and cannot be rubbed off with the fingers, when examined.

Having a lot of organic matter in the soil will encourage beneficial microbes that attack root knot nematode. Good rotation of crops will also reduce the infestation.

Other legume pests

Aphids, whitefly, caterpillars and leaf miner.

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MAIN LEGUME DISEASES

- Halo blight
- Common rust
- Angular leaf spot
- Powdery mildew
- Fusarium wilt

Uwezo

Syngenta make a series of good quality, reliable pesticides in pack sizes suitable for small-scale farmers – the series is called UWEZO. Uwezo is stocked by most agrovets in Kenya. The pack sizes are sufficient to use in one 15 litre spray tank.

Check the Labels and use the product specific to the pest present. Do not spray if the pest levels are not high. Observe all health and safety instructions and leave the recommended number of days after spraying before picking any produce